Air Quality

Photo by Richard Fields, Indiana Department of Natural Resources.

They's something kindo' harty-like about the atmusfere
When the heat of summer's over and the coolin' fall is here —
Of course we miss the flowers, and the blossums on the trees,
And the mumble of the hummin'-birds and buzzin' of the bees;
But the air's so appetizin'; and the landscape through the haze
Of a crisp and sunny morning of the airly autumn days
Is a pictur' that no painter has the colorin' to mock
When the frost is on the punkin and the fodder's in the shock.

"When The Frost is on The Punkin"

James Whitcomb Riley (1849-1916)

AIR POLLUTION

Indiana's air has become significantly cleaner in the last 10 years. Stricter standards and better compliance by industry have reduced smog and dust levels and improved visibility. Indiana's air meets health standards set by the U.S. Environmental Protection Agency (EPA) for sulfur dioxide, carbon monoxide, lead, dust and soot at air quality monitors located across the state. However, in some parts of the state on some hot, sunny days, ozone levels still exceed federal standards. Levels of toxic chemicals, for which there are no federal health standards, are also of concern in Indiana.

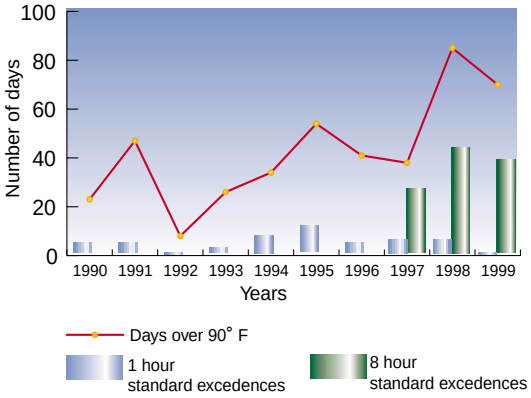
Air pollution can have numerous health effects. Children, the elderly and people with lung diseases are especially susceptible to health complications from air pollution. Pollutants in the air we breathe can cause a scratchy throat, coughing, difficulty breathing, watery eyes, inflamed lung tissue, aggravated asthma, lung disease, cancer, reduced immune defenses and other problems. Air pollution comes from motor vehicles, industry and many other everyday activities.

OZONE

Ozone in the upper atmosphere is the "good" ozone that protects us from the sun's radiation. Ground-level ozone, which is formed when volatile organic compounds (VOCs), nitrogen oxides (NOx) and sunlight mix, is the "bad" ozone that irritates lungs and causes significant health problems for many people. Ozone is an air quality problem in the summer months when temperatures and sunlight are the greatest. Ozone can lead to reduced lung function, increased respiratory inflammation, coughing, chest pain and nausea. Children are especially at risk from ground-level ozone, because they breathe more air per pound than adults and spend more time outdoors.

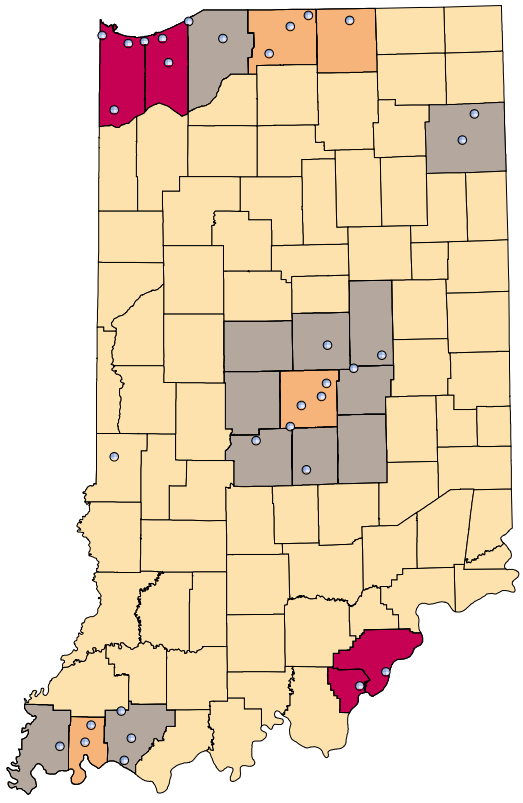
Historically, the nation's ozone standard was 125 parts per billion, measured over one hour. Indiana monitors ozone in areas where ozone levels are expected to be high, due to dense population and manufacturing activities. When a monitor in an area exceeded the standard more than once a year or average, that area violated the standard. The air quality in all Indiana counties now meets the one-hour standard except for Clark and Floyd counties in southeastern Indiana. In those counties, however, the number of days during the summer months when ozone levels exceed the standard has decreased, and ozone levels are not as high. In Lake and Porter counties, air quality recently has met the one-hour standard, but these counties are part of a larger metropolitan area that does not meet the standard. In July 1997, EPA established a stricter ozone standard based on health studies addressing longer term exposure. This standard requires concentrations of ozone of less than 85 parts per billion, measured over eight hours, and more closely reflects exposure to people who work and play outside in the summer. Six metropolitan areas in Indiana are at risk for not meeting the eight-hour standard, but a legal challenge has delayed enforcement of that standard.

Indiana unhealthy ozone days



*IDEM began recording 8-hour ozone values in 1997 when U.S. EPA adopted the standard.

Areas not likely to meet the ozone standard



At risk – Historically met 1-hour standard.
At risk of not meeting 8-hour standard.

Maintenance – Recently met 1-hour standard.
At risk of not meeting 8-hour standard.

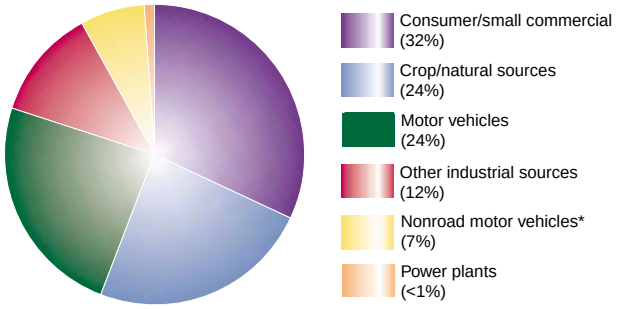
Violates 1-hour standard.
Not likely to meet 8-hour standard.

Ozone monitor locations.

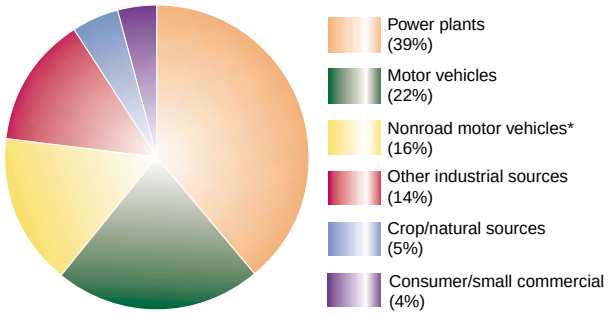
Map and chart source: IDEM Office of Air Management, 2000

Major contributors to ozone

Sources of volatile organic compounds in Indiana

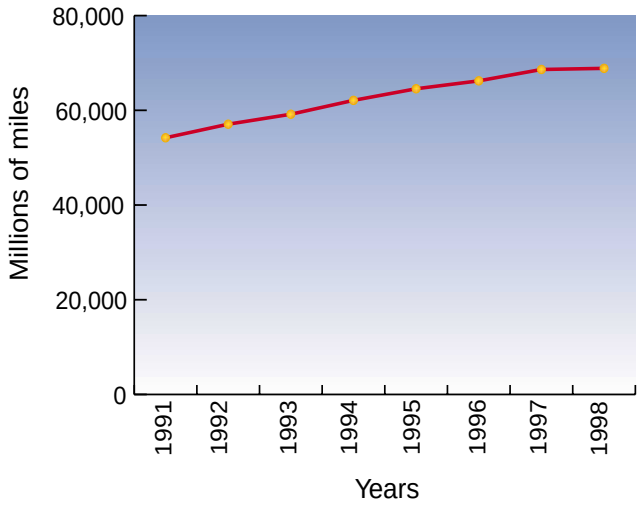


Sources of nitrogen oxides in Indiana



* Nonroad motor vehicles – agriculture, lawn, recreational and construction equipment

Annual vehicle miles traveled in Indiana



Graph and charts source: IDEM Office of Air Management, 1999

Ozone sources

Ozone levels are typically higher in urban areas. Motor vehicles, manufacturing, industrial and everyday activities emit nitrogen oxides and volatile organic compounds that react in sunlight to form ozone. Pollutants that cause ozone include gasoline vapors, chemical solvents and combustible fuels. Certain emissions can cause ozone at greater distances. Emissions of nitrogen oxides from tall sources, such as smoke stacks, are more likely than sources near ground level to travel downwind and increase ozone levels in surrounding urban and rural areas.

Vehicle Miles Traveled

Cars and trucks are important sources of carbon monoxide, nitrogen oxides, particulate matter and volatile organic compound emissions. Vehicle miles traveled is used to estimate emissions of these pollutants.

In 1998, Hoosiers drove 68 million miles annually, an average of 188 thousand miles per day. From 1991 to 1998, annual vehicle miles traveled increased by 21 percent; Indiana's population increased by about seven percent during the same period. The increasing rate of vehicle miles traveled reduces the air quality benefits from cleaner vehicles and fuels. By 2010, data projections indicate that Hoosiers will travel more than 100,000 million vehicle miles annually. Other environmental and economic impacts result from increased traffic congestion and additional road construction and maintenance.

Regional nature of ozone

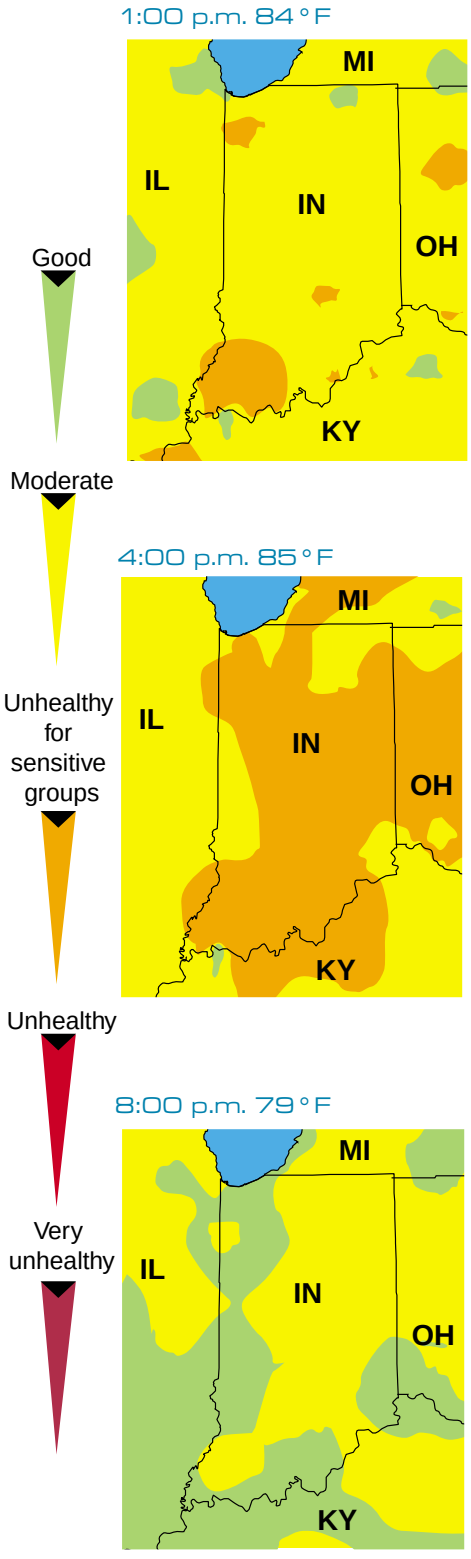
Ozone is generated locally and transported from upwind sources. Ozone and the pollutants that form it can be carried significant distances downwind from their points of origin.

Ozone is generated throughout the state and regionally especially within urban areas, and is transported across county, state and national boundaries. Indiana's cars, factories and other human activities generate ozone that is transported within Indiana and to other states. In turn, ozone generated by our neighboring states is carried across our borders and affects the quality of air Indiana's citizens breathe. Consequently, Indiana communities that do not meet ozone health standards cannot solve ozone problems alone. Many actions are occurring at the local, state and federal levels to reduce the pollutants in the Midwest that cause ozone. In mid-June, 1999, Indiana experienced a period of several days with light winds and sunny warm weather, conditions which are ideal for ozone formation. Temperatures across the state were in the 60s in the early morning, the 70s during the midmorning hours, the mid 80s in the afternoon, and the 70s during the evening hours. The adjacent maps show eight hour average ozone concentrations as they changed on June 21, 1999. One can see how the concentrations climb through the day as temperatures reach the mid 80s during the afternoon and then begin to fall as the temperatures cool off in the evening. The ozone levels are based on monitoring data put into a model that shows regional ozone patterns. The maps also demonstrate how ozone spreads and that it is not necessarily concentrated in urban areas.

IDEM's *Smog Watch* web page provides Indiana citizens with information and data concerning ozone levels across the state. *Smog Watch* will alert you to Ozone Action Days (summertime days with unhealthy levels of ozone) and allow you to view actual hourly ozone data recorded at ozone monitoring sites around the state. You can also view the highest ozone value recorded the previous day. *Smog Watch* is your link to Indiana's ozone monitoring network and information concerning ozone pollution.

To access *Smog Watch* during Indiana's Ozone Season (April 1 through September 30), go to the IDEM homepage at *http://www.state.in.us/idem/index.html* and click on the Smog Watch icon.

Ozone 8-hour values on June 21, 1999



Source: U.S. Environmental Protection Agency, 1999

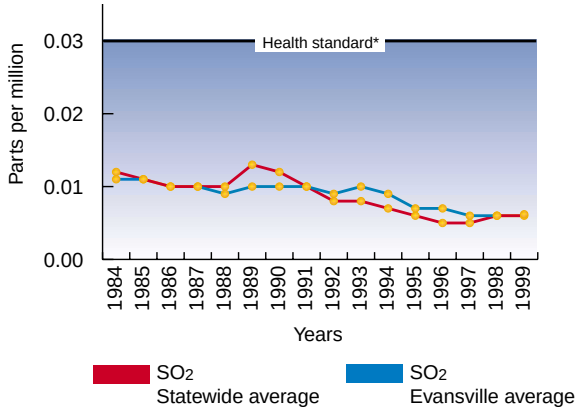
SULFUR DIOXIDE

Populations particularly sensitive to sulfur dioxide include children, older adults, asthmatics and people with chronic lung and cardiovascular disease. Sulfur dioxide is a primary component of acid rain, which is discussed on page 13.

Sulfur dioxide levels in Indiana's air have decreased dramatically. All areas of Indiana currently meet state and federal health standards for sulfur dioxide as measured by air quality monitors. Many Indiana power plants have greatly reduced sulfur dioxide emissions by using low-sulfur coal, increasing use of lower polluting boilers, investing in air pollution control equipment, such as scrubbers.

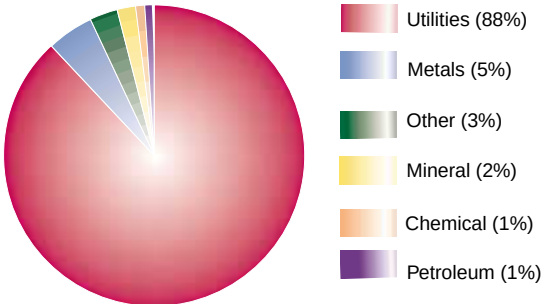
The top graph demonstrates levels of sulfur dioxide have decreased since the mid-1980s in Evansville, an area heavily influenced by power plants, where annual averages remain well below the health standard.

Sulfur dioxide air quality
Statewide and Evansville average

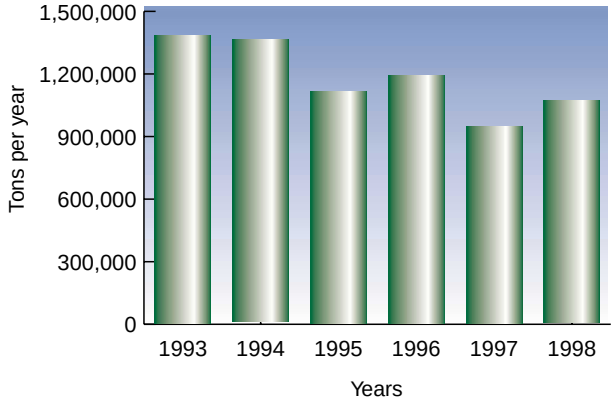


*The federal health standard is .03 ppm measured over 24 hours.

Indiana sulfur dioxide emissions by industry



Indiana industrial sulfur dioxide total emissions



Graphs and chart source: IDEM Office of Air Management, 1999

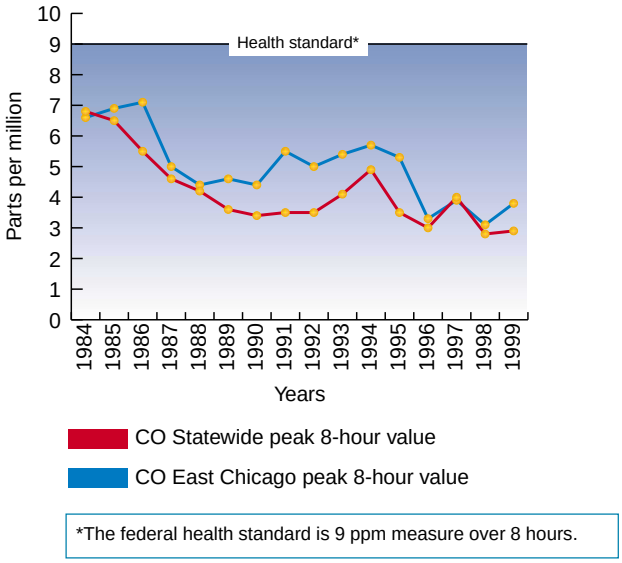
CARBON MONOXIDE

Carbon monoxide in the bloodstream reduces the flow of oxygen to tissues and organs, thereby reducing vision and coordination, and causing dizziness and reduced learning ability. Carbon monoxide is formed from incomplete combustion. Sources of carbon monoxide include vehicles, industrial processes and fuel combustion in boilers and incinerators.

All areas of Indiana currently meet federal health standards for carbon monoxide. Carbon monoxide levels continue to improve, primarily due to stricter emission standards for new cars and improved combustion techniques and emission controls.

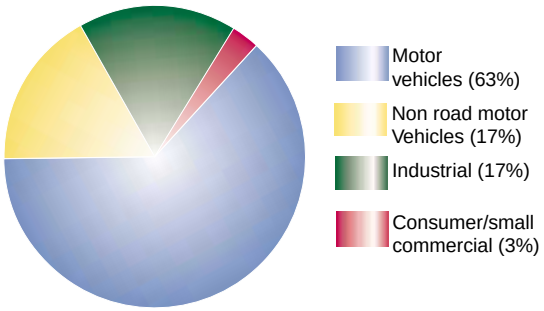
Levels of carbon monoxide have generally declined since the mid 1980s. The top graph demonstrates in areas such as East Chicago, where levels of carbon monoxide were below the health standard but often above the Indiana peak 8-hour value, carbon monoxide levels have decreased overall since the mid 1980s.

Carbon monoxide air quality
Statewide and East Chicago peak 8-hour value



*The federal health standard is 9 ppm measure over 8 hours.

Indiana carbon monoxide emissions



Indiana industrial carbon monoxide emissions

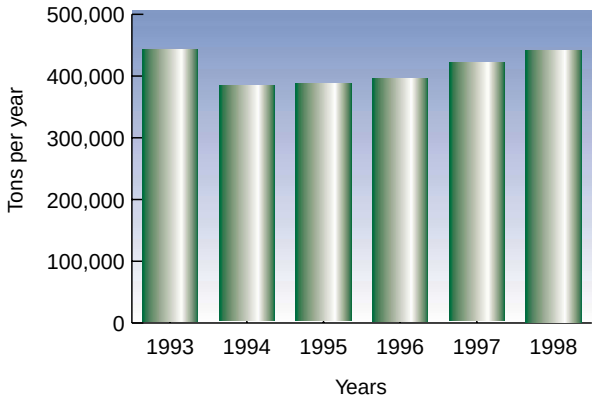
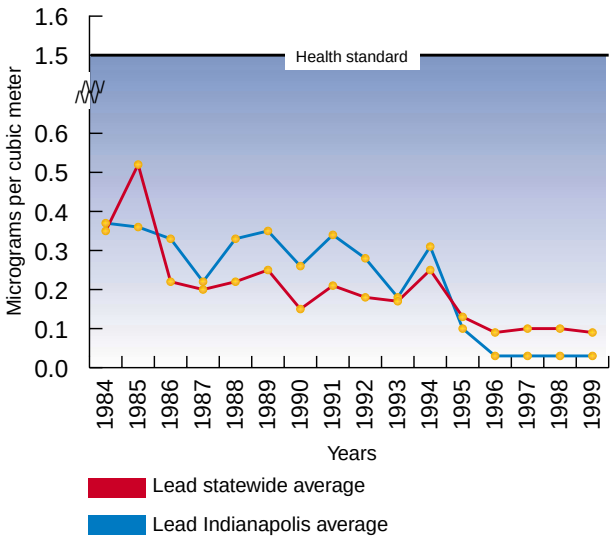
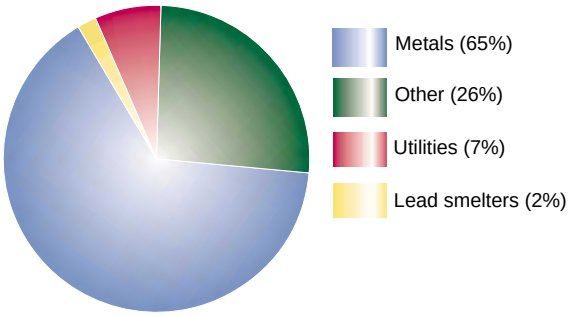


Chart and graphs source: IDEM Office of Air Management, 1999

Lead air quality
Statewide and Indianapolis composite average



Indiana lead emissions by industry



Indiana industrial lead emissions

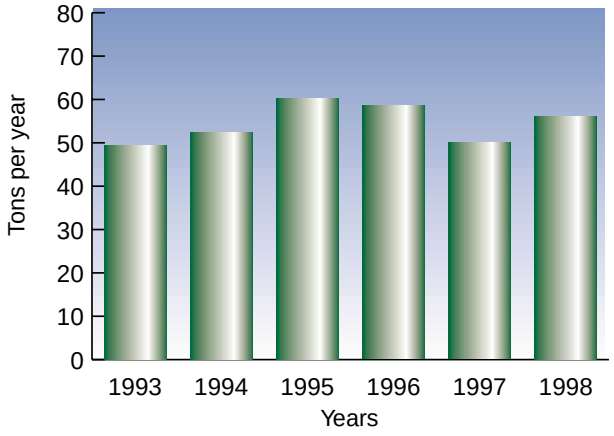


Chart and graphs source: IDEM Office of Air Management, 1999

LEAD

Excessive exposure to lead can result in lead poisoning and elevated blood-lead levels, which may cause mental and physical damage to young children. In the past, the major source of lead was motor vehicles. The prohibition of leaded gasoline has significantly lowered lead levels in the air. The remaining sources of lead include lead paint in older homes, contaminated soils and facilities that process or produce materials that contain lead. Aggressive state rules that limit emissions from these facilities have helped assure that no areas of Indiana have unhealthy lead levels in the air.

The top chart demonstrates, in Indianapolis, regulations and the closing of a lead processing facility have resulted in dramatic reductions in airborne lead.

For more information about lead in Indiana's environment, see *Chemicals on page 48*.

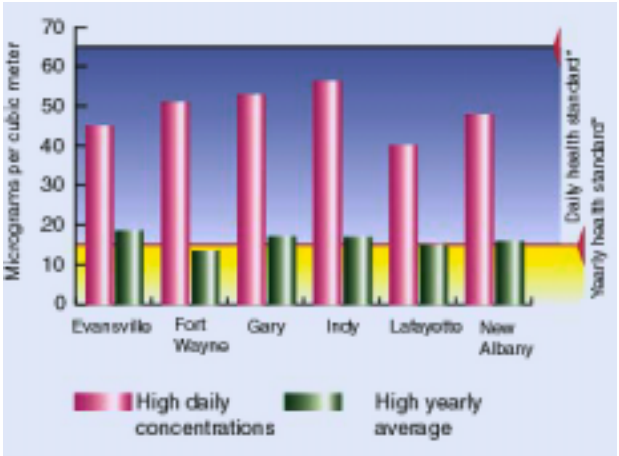
DUST AND SOOT

Particulates are small pieces of aerosol mists, dust, dirt and soot emitted by sources such as cars, trucks, construction projects, factories, unpaved roads, fireplaces and wood stoves. Older adults, children and people with chronic lung disease are especially sensitive to particulates.

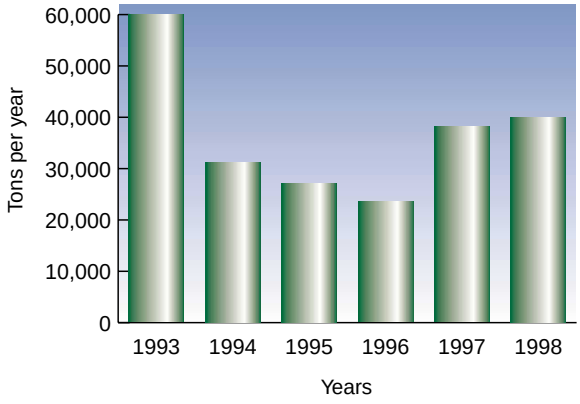
Recent studies indicate that the smallest particulates pose the most serious health threat, because they can be inhaled more deeply into the lungs and are more difficult to exhale. In 1997, EPA established a new standard for particulates less than 2.5 micrometers (PM 2.5), or 25 times narrower than a strand of human hair. Although a legal challenge has delayed enforcement of the PM 2.5 standard, Indiana, like other states, has established monitoring sites for PM 2.5. IDEM has 39 monitors located throughout the state to evaluate the new standard. After three years of data have been collected from these monitors, IDEM and EPA will determine whether any areas in Indiana exceed the new health standard for small particulates. During this time period, EPA will continue to review the PM 2.5 standard.

Data have been collected on larger particles, PM 10, for a number of years. Levels of PM 10 in Indiana's air have fallen dramatically since the mid 1980s, especially in areas such as Gary, where health standards previously had been exceeded

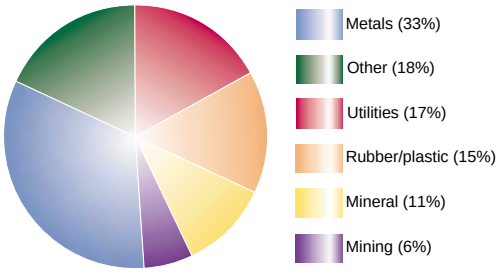
1999 Fine particulate air quality (PM 2.5)



Indiana industrial dust and soot emissions



Indiana dust and soot emissions by industry



Particulate matter air quality (PM10) Statewide and Gary average

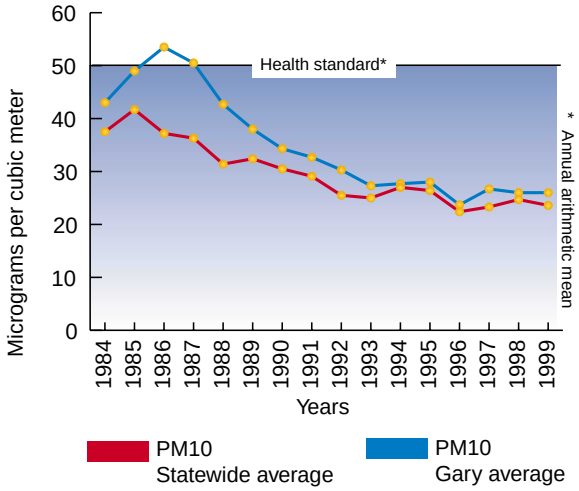
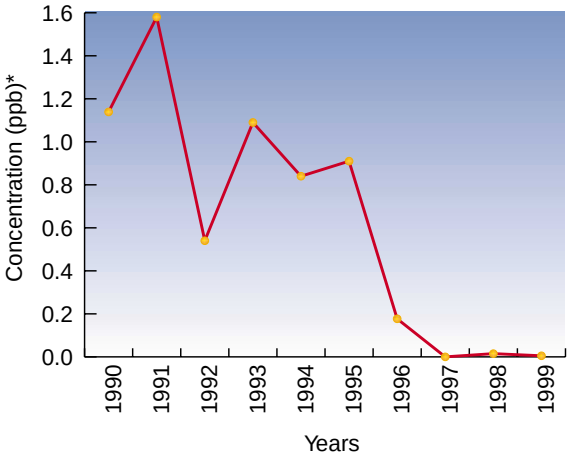


Chart and graphs source: IDEM Office of Air Management, 1999

Hammond 1,2-dichloroethane annual average



*ppb - parts per billion

Data from all of the IDEM operated air toxic monitoring sites and health effects information on all of the monitored compounds can be found on the IDEM "ToxWatch" web site at www.state.in.us/idem/oam/toxwatch/. IDEM is beginning to evaluate the information from the new monitors. Future State of the Environment reports will contain this information.

Graph source: IDEM, Office of Air Management 1999

AIRBORNE TOXIC AND OTHER ORGANIC COMPOUNDS

Many chemicals in the air affect human health and the environment. Some chemicals occur naturally. Others are released by a variety of human activities, such as manufacturing, driving, cleaning or painting. Some of these chemicals can cause health problems at very low concentrations. For some chemicals, the effects are immediate; for others, they are longer term, including a possible increased risk of certain cancers.

EPA has designated 188 chemicals as "air toxics," because they are known to cause serious health impacts. Other specific chemicals contribute to the formation of ozone.

Monitoring for airborne toxics and other organic compounds began in Indiana in 1987 at a site in Hammond. Since 1987, both the number of monitoring sites and the number of chemicals being measured have increased. The chart shows historical trends of one chemical, 1,2-dichloroethane (EDC), at this location. This chemical is primarily released from one chemical plant in Hammond. Additional monitoring for 87 toxics and ozone causing chemicals began in 1999, with monitoring stations in Elkhart, Indianapolis, Evansville, and Gary.

GLOBAL CLIMATE CHANGE

Recent data continue to confirm that global near-surface temperatures during the 20th century have been rising. For 1999, the National Oceanic and Atmospheric Administration projected that the United States had experienced its second warmest year on record since 1900. A long-term warming trend has been observed in the United States (0.5 degrees Celsius per century), with a substantial portion of the warming occurring since the mid-1970s.

Greenhouse gases in the atmosphere, such as carbon dioxide, methane and chlorofluorocarbons, trap the earth's heat and are

thought by many scientists to be the cause of rising global temperatures. Global warming could change rain and temperature patterns and affect Indiana's agriculture and quality of life.

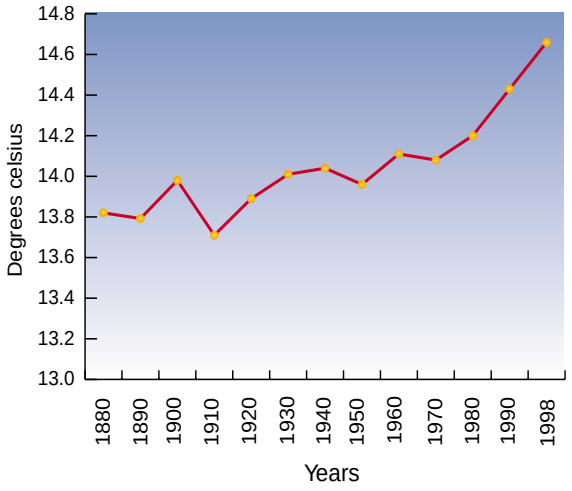
Carbon dioxide, the primary greenhouse gas, occurs naturally, is exhaled by humans and animals, and is created by the combustion of fossil fuels. The global concentration of carbon dioxide has increased significantly in the modern industrial age. In the United States, about 37 percent of carbon dioxide emissions caused by human activities are produced by electric utility generators. In 1998, Indiana electric utilities released an estimated 137 million tons of carbon dioxide. Energy conservation and the use of nonfossil fuels are ways to decrease the production of carbon dioxide.

ACID RAIN

Acid rain results from reactions involving sulfur dioxide, nitrogen oxides and rainfall. Natural sources, such as decaying plant life and volcanic eruptions contribute to acid rain. However, human sources, including the burning of fossil fuels and motor vehicle emissions, cause most acid rain.

Acid rain harms our aquatic life, causes the decay and corrosion of cars, paints, buildings and statues. It also damages forests and crops by affecting soil nutrients and killing essential bacteria. Acid rain does not cause significant problems for much of Indiana because soils and waterways are limestone-based and act as a natural buffer to acidic rainfall. Also, sulfur dioxide and nitrogen oxide emissions have been greatly reduced in recent years.

Global average temperatures, 1880-1998



Graph source: NASA Goddard Institute for Space studies, 1999

Indiana carbon dioxide emissions

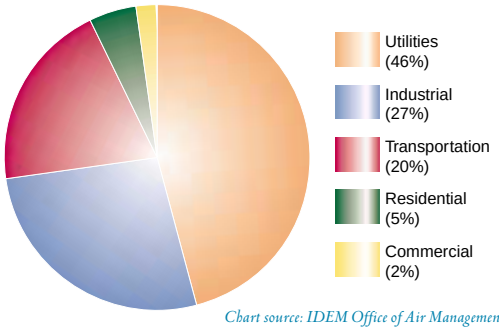
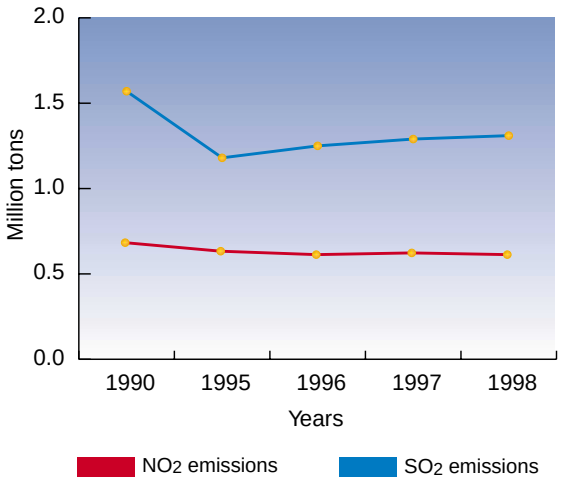


Chart source: IDEM Office of Air Management, 1999

National NO_2 and SO_2 emission trends for large electric power generators



Source: U.S. Environmental Protection Agency, Acid Rain Program Emissions Scorecard, 1998

The next page which is blank in the print report, page number 14, has been omitted from this on-line version.

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